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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/056,533	01/23/2002	Ying Jia	42390P10369	6044

7590 12/23/2004

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EXAMINER	
ALBERTALLI, BRIAN LOUIS	

ART UNIT	PAPER NUMBER
2655	

DATE MAILED: 12/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/056,533	Applicant(s) JIA ET AL.	
	Examiner Brian L Albertalli	Art Unit 2655	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-13,15-20,22-24 and 26-30* is/are rejected.

7)☒ Claim(s) *6,14,21 and 25* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *6/25/02*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 6, 10, 14, 21, and 25 are objected to because of the following informalities: none of the claims, or their respective parent claims, describe what the variables in the equations represent. For example, there is no explanation of what the variable A stands for, or what the variable $H^{(r)}$ stands for. Language such as "where A is the feature space transformation" should be added to the claims. Appropriate correction is required.

2. Claims 7 and 22 are objected to because in line 3 of each of the claims, "MFT" should be –MST--.

3. Claims 15 and 26 are objected to because the terms FST and MST lack antecedent basis in the parent claims. Parent claims 12 and 23 only mention "a first transformation matrix" and a "second transformation matrix".

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1-5, 7 and 11-13, 15-20, 22-24, and 26-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gopinath et al. (U.S. Patent 6,609,093), in view of Gales (*Semi-Tied Covariance Matrices for Hidden Markov Models*).

In regard to claims 1, 4, 12, 16, 19, 23, 27, 28, and 29, Gopinath et al. disclose receiving a speech data stream (column 8, lines 1-3);

performing a Mel Frequency Cepstral Coefficients (MFFC) feature extraction on the speech data stream (features are extracted in a well known manner, column 8, lines 1-3; MFCC is a standard extraction scheme, column 1, lines 22-24);

optimizing feature space transformation (FST) (column 7, equation 8 (DHDA) is an objective function that maximizes the feature space transformation θ; column 7, line 2; θ is the transformation that is applied to an input vector x to map the input vector x to an estimate vector y for recognition, column 4,liens 55-61); and

performing recognition decoding based on the FST, generating a word sequence (the transformed features are provided to a classifier to perform a hypothesis search routine, the results of which are further processed by a natural language understanding module to identify valid phrases, Fig. 1, 26 and 28, column 8, lines 62-65 and column 9, lines 8-23).

Gopinath et al. further disclose that the DHDA of equation 8 is based on the feature space transformation θ, determined by the objective function given in equation 3, as well as a transformation Ψ, given in equation 7. Based on the fact that the Heteroscedastic Discriminant Analysis (HDA) is invariant subsequent feature space transformations, equation 3 and equation 7 are combined to create equation 8 (column

6, line 60 to column 7, line 2). Furthermore, equation 7 is a maximum likelihood linear transform (MLLR) as described in Gales (column 6, lines 45-47). Additionally, Gopinath et al. disclose that the transform described in Gales is applied in model space (column 2, lines 39-43).

Gopinath et al. do not explicitly disclose optimizing model space transformation MST) based on the FST; and

performing the decoding based on the FST and the MST.

As mentioned above, Gales discloses a transform (semi tied transform $H^{(r)}$) applied in model space (page 272, second column, lines 20-21 and page 274, first column, section III, lines 7-8) and the objective function (page 274, second column, equation 15) to optimize the model space transformation (page 274 second column lines 1-3). Note that in equation 15, the inverse of $H^{(r)}$, $A^{(r)}$ is used for simplicity ($A^{(r)} = H^{(r)-1}$).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Gopinath et al. to use the model space transformation disclosed in Gales in the combination used to create the objective function disclosed by Gopinath et al., because the model space transformation reduces the word error rate by 10% over a standard system with little increase in the number of parameters or computational cost, as taught by Gales (page 280, section VII, lines 14-18).

Furthermore, in regard to claims 4, 12, 19, 23, 28, and 29, Official notice is taken that it is notoriously well known and recognized in the art to optimize an objective function jointly and simultaneously.

It would have been obvious to one of ordinary skill in the art at the time of invention to further modify the combination of Gopinath et al. and Gales to solve to optimize the objective function jointly and simultaneously, since this would provide the fastest and most accurate optimization of the FST and the MST.

In regard to claims 2 and 17, Gopinath et al. disclose the optimization of the FST is performed through a linear discriminant analysis (LDA) (an HDA is used, which is an extension, or generalization, of the LDA, column 6, line 67 and column 2, lines 54-58). Furthermore, the combination of Gopinath et al. and Gales, as applied to claims 1 and 16, above, would necessarily create an objective function that was dependent on both the FST and the MST.

Gopinath et al. do not disclose the optimization of the FST is based on an initial MST.

Gales discloses an algorithm for optimizing a transformation wherein one parameter is initialized to a current estimate and used to estimate a second parameter in an iterative operation (page 275, first column, lines 4-20).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Gopinath et al. to optimize the FST based on an initial MST, since this provides convergence in very few iterations, as taught by Gales (page 276, second column, section V, lines 20-24).

In regard to claims 3 and 18, the combination of Gopinath et al. and Gales et al., as applied to claims 1 and 16, above, disclose in Gales et al. that the MST is performed through a full covariance transformation (FCT) (see page 274, equation 13, the covariance matrix is used to derive equation 15, page 274, first column, section III, lines 8-11).

In regard to claims 5, 13, 20, 24, and 30 the combination of Gopinath et al. and Gales, as applied to claims 1 and 16, above would necessarily create an objective function that was dependent on both the FST and the MST. Furthermore, the combination of Gopinath et al. and Gales, as applied to claims 1 and 16, above discloses in Gales optimizing parameters through objective function such that the objective function reaches a predetermined state (appropriate criterion are satisfied, page 275, first column, lines 18-19).

It would have been obvious to one of ordinary skill in the art at the time of invention to further modify the combination of Gopinath et al. and Gale to optimize the FST and the MST once the objective function reached a predetermined state, because since the iterative scheme converges in very few iterations, as taught by Gales (page 276, second column, section V, lines 20-24), it would not be necessary to continue iterations after that point.

In regard to claims 7, 15, 22, 26, Gopinath et al. disclose examining the word sequence to determine if the word sequence is satisfied (language model score determines if the word sequence fits grammatical constraints, column 9, lines 9-12).

Neither Gopinath et al. nor Gales disclose repeating optimization of FST based on the previously optimized MST, and repeating optimization of MST based on the newly optimized FST, if the word sequence is not satisfied.

Official notice is taken that it is notoriously well known and recognized in the art to retrain a speech recognizer based on incorrect recognition results in order to improve the accuracy of the speech recognizer.

It would have been obvious to one of ordinary skill in the art at the time of invention to further modify the combination of Gopinath et al. and Gales to repeat optimization of FST based on the previously optimized MST, and repeat optimization of MST based on the newly optimized FST, if the word sequence was not satisfied, in order to increase the accuracy of the speech recognizer.

In regard to claim 11, the combination of Gopinath et al. and Gales, as applied to claims 1 and 16, above, would necessarily create an objective function that was dependent on both the FST and the MST.

Gopinath et al. do not disclose the optimization of the MST is performed through an iterative optimization of a procedure, based on the FST.

Gales discloses an algorithm for optimizing a transformation wherein one parameter is initialized to a current estimate and used to estimate a second parameter in an iterative operation (page 275, first column, lines 4-20).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Gopinath et al. to optimize the MST through a iterative procedure based on the FST, since this provides convergence in very few iterations, as taught by Gales (page 276, second column, section V, lines 20-24).

6. Claims 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gopinath et al, in view of Gales, and further in view of Kumar. (*Investigation of Silicon Auditory Models and Generalization of Linear Discriminant Analysis for Improved Speech Recognition*).

Gopinath et al. and Gales do not disclose any of the features of the instant claim.

Kumar et al. disclose the optimization of a FST that is performed through an eigenvalue analysis of a matrix where the matrix comprises a matrix of $W^{-1}B$ (page 68, section 5.1.3, lines 11-13). Furthermore, Kumar et al. discloses an optimization wherein the objective function comprises the equation given in claim 10 (page 68, equation 5.31, θ in Kumar et al. corresponds with A in the claim).

It would have been obvious to one of ordinary skill in the art at the time of invention to further modify the combination of Gopinath et al. and Gales to optimize the FST with the methods as disclosed by Kumar et al, because eigenvalue routines have

already been optimized over several decades to work fast, as taught by Kumar (page 68, section 5.1.4, lines 1-3).

Allowable Subject Matter

Claims 6, 14, 21, and 25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: the prior art of record does not disclose the jointly optimizable objective function as disclosed in claims 6, 14, 21, and 25. Furthermore, the prior art of record would not have suggested to one of ordinary skill in the art how to derive the specific jointly optimizable objective function as disclosed in claims 6, 14, 21, and 25.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Luginbuhl et al. (U.S. Patent 5,473,728) disclose an additional method of Heteroscedastic Discriminant Analysis. Moon et al. (*Robust Speech Recognition Based on Joint Model and Feature Space Optimization of Hidden Markov Models*) and Hwang et al. (*Joint Model and Feature Space Optimization for Robust Speech Recognition*) disclose a method for jointly optimizing the model and feature

space through HMM inversion and the robust minimax technique. Wang et al. (*Selective Feature Extraction via Signal Decomposition*) disclose a method for jointly optimizing a classifier and feature extractor using a statistical matching pursuit algorithm. Sankar et al. (*An Experimental Study of Acoustic Adaptation Algorithms*) disclose model space transformations reduce word error rate more that feature space transformations. Goel et al. (*Multiple-Linear Transforms*) disclose a method that improves the performance of a Maximum Likelihood Linear Transform. Schukat-Talamazzini et al. (*Optimal Linear Feature Transformations for Semi-Continuous Hidden Markov Models*) disclose a maximum likelihood rotation method for optimal feature reduction. Saon et al. (*Maximum Likelihood Discriminant Feature Spaces*) disclose similar techniques as those presented in Gopinath et al.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L Albertalli whose telephone number is (703) 305-1817. The examiner can normally be reached on Mon - Fri, 8:00 AM - 5:30 PM, every second Fri off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Talivaldis Smits can be reached on (703) 305-3011. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BLA 12/17/04

TĀLIVALDIS IVARS ŠMITS
PRIMARY EXAMINER